Introduction to AGWA2

The Automated Geospatial Watershed Assessment Tool

Modeling post-fire rehabilitation using the Land Cover Modification Tool

Introduction	In this exercise you will assess a simulated fire treatment to a burned watershed using the Land Cover Modification Tool.
Goal	To familiarize you with the Land Cover Modification Tool for use as a burn treatment analysis tool.
Assignment	Run the KINEROS model parameterized with post-fire land cover, then modify the land cover using the Land Cover Modification Tool to parameterize the models with treated, post-fire land cover.

Background

Wildfires can, and have had, a profound impact on the nature of watershed response to precipitation (DeBano et al. 1998). Increases in peak runoff rate and volume, as well as sediment discharge, typically increase following fires, (Robichaud, et al. 2000; Anderson et al. 1976). Mitigating these effects is one of the primary objectives of the Burned Area Emergency Response (BAER) teams. Weather and climatic conditions often force these teams to make rapid post-fire assessments for decision-making on how and where to deploy remediation measures. Building and running distributed hydrological models to predict potential impacts of fire on runoff and erosion can be a time-consuming and tedious task. The USDA-ARS Southwest Watershed Research Center, in cooperation with the U.S. EPA Office of Research and Development, and the University of Arizona have developed the AGWA geographic information system (GIS) based tool to facilitate this process. A GIS provides the framework within which spatially-distributed data are collected and used to prepare model input files and evaluate model results in a spatially explicit context.

The Study Area

The Aspen Fire in June of 2003 burned 84,750 acres on Mount Lemmon. Mount Lemmon is located in the Santa Catalina Mountains north of Tucson, AZ (Figure 1). The burned area intersects several drainages on the mountain, including Molino Canyon, Sabino Canyon, Ventana Canyon, Romero Canyon, Canyon Del Oro, Peppersauce Wash, Catalina Wash, and Stratton Wash. This exercise will focus on the impacts of the fire on the Marshall Gulch watershed (873 ha), a subwatershed of the larger Sabino Canyon watershed (16,478 ha).

The Land Cover Modification Tool in AGWA will be used to create a treated version of the National Land Cover Data 2001 (NLCD 2001) already modified to represent the effects of the fire. The post-fire NLCD 2001 dataset and the treated, post-fire NLCD 2001 dataset will be used to parameterize the KINematic Runoff and EROSion Model (KINEROS2; Semmens et al., 2008; www.tucson.ars.ag.gov/kineros)*. A discussion on the selection of parameter values used to parameterize the model for simulating post-fire

* Available in PDF format on the AGWA website, http://www.tucson.ars.ag.gov/agwa/.

runoff and sediment transport is presented by Canfield et al. (2005)[* above] and Goodrich et al. (2005)[* above].

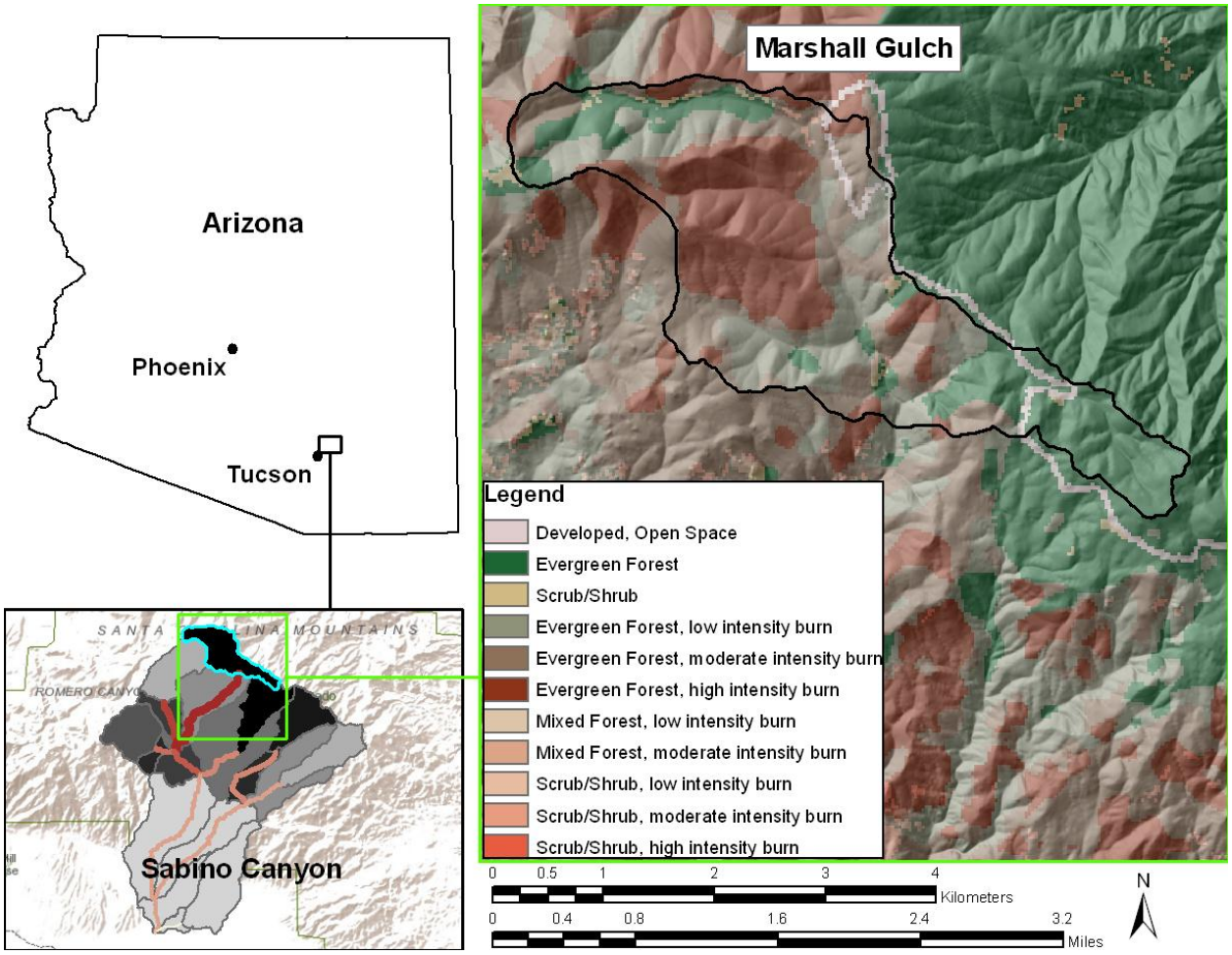


Figure 1. Location Map of the study area, near Tucson, Arizona.

This exercise examines the effects of a typical burn treatment on the hydrology of a particular burned watershed in the Santa Catalina Mountains. The results disclose potential immediate changes to the hydrologic regime that are attributable to effective recovery efforts. Changes include the reduction in sediment yield and decrease of higher runoff peaks.

Getting Started

Start ArcMap with a new empty map. Save the empty map document as **tutorial_MarschallGulchRehabilitation**. Turn on the AGWA2 Toolbar if it is not already on. Once the map document is opened and saved, set the HOME and TEMP directories to **C:\AGWA2** and **C:\AGWA2\temp**, respectively.

GIS Data

Add the GIS data to the map by clicking on the *Add Data* button  below the menu bar at the top of the screen. Navigate to the C:\AGWA2\gisdata\tutorials\tutorial_MarshallGulchRehabilitation\ folder and add the following datasets and layers:

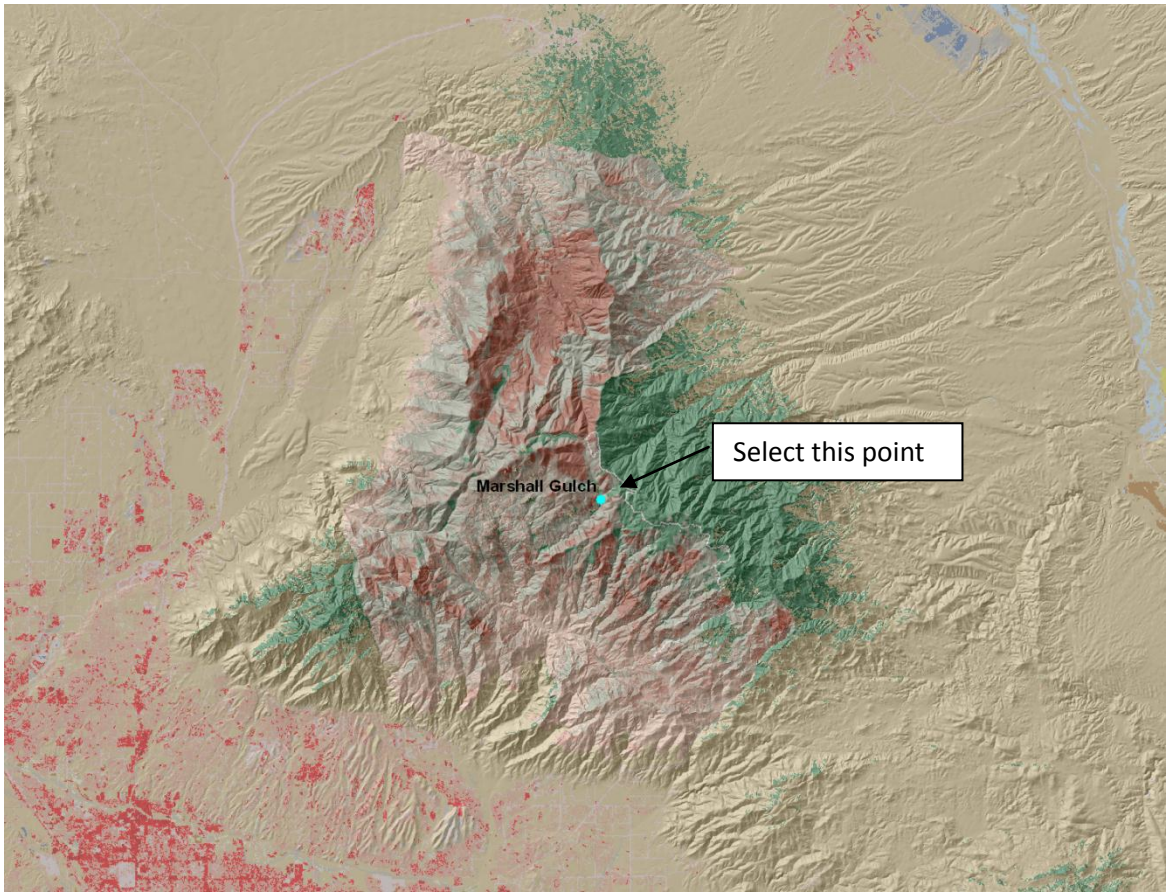
- gsmsoil_az\spatial\gsmsoilmu_a_az.shp
- aspenfire\
    - demf
    - facg
    - fdg
    - hillshade
    - marshall_gulch_outlet.shp
    - postfire
    - stream5000
    - treatment.shp

You may want to collapse the legends and rearrange the orders of the layers to better see what is going on. Click on the minus box next to the layer name in the Table of Contents to collapse the legend. Click and drag the layers by their names in Table of Contents.

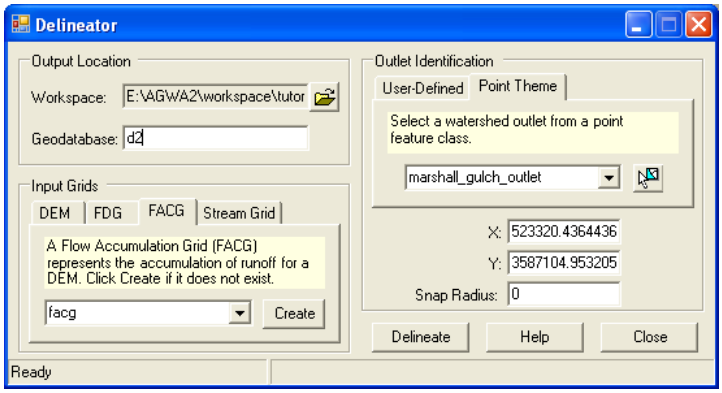
You will also need to add the following database file from the C:\AGWA2\datafiles\lc_luts folder:

- mrlc2001_lut_fire.dbf – MRLC look-up table for post-fire and treated NLCD land cover

Part 1: Modeling Runoff in Study Area Using Existing Post-Fire Land Cover



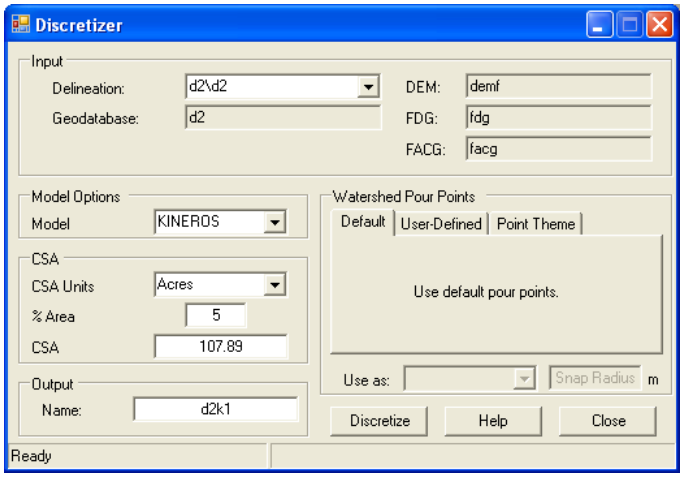
1. Perform the watershed delineation by selecting the *Delineate New Watershed* menu item from the *AGWA2 Tools -> Delineation Options* menu.



   A. *Output Location* box
      I. *Workspace* textbox: navigate to and create /select **C:\AGWA2\workspace\tutorial_MarshallGulchRehabilitation**
      II. *Geodatabase* textbox: **d2**
   B. *Input Grids* box
      I. *DEM* tab: select **demf** (do not click Fill)
      II. *FDG* tab: select **fdg** (do not click Create)
      III. *FACG* tab: select **facg** (do not click Create)

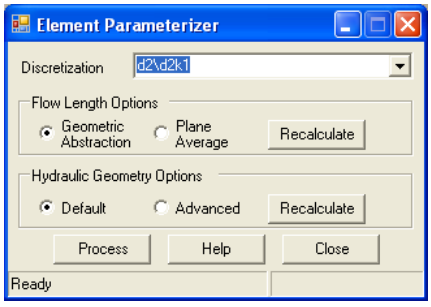
C. *Outlet Identification* box
    I. Select the *Point Theme* tab
    II. Select the **marshall_gulch_outlet** layer from the combobox.
    III. Click the Select Feature button and draw a rectangle around the box **Marshall Gulch** point (see map above).
D. Click *Delineate*.

2. Perform the watershed discretization by selecting the *Discretize Watershed* menu item from the *AGWA2 Tools -> Discretization Options* menu.



A. *Input* box
    I. *Delineation*: select **d2\d2**
B. *Model Options* box
    I. *Model*: select **KINEROS**
C. *CSA* box
    I. *CSA Units*: select **Acres**
    II. *% Area*: Change to **5**
    III. **CSA**: it should read **107.89** after changing the *% Area* to 5.
D. *Output* box
    I. *Name*: enter **d2k1**
E. Click *Discretize*.

3. Perform the element parameterization of the watershed by selecting the *Element Parameterizer* menu item from the *AGWA2 Tools -> Parameterization Options* menu.



A. *Discretization* combobox: select **d2\d2k1**
B. *Flow Length Options* box: select the **Geometric Abstraction** radiobutton

C. *Hydraulic Geometry Options* box: select the ***Default*** radiobutton

D. Click *Process*.

4. Perform the land cover and soils parameterization of the watershed by selecting the *Land Cover and Soils Parameterization* menu item from the *AGWA2 Tools -> Parameterization Options* menu.

A. *Watershed* tab

I. *Discretization*: select **d2\d2k1**

B. *Land Cover* tab

I. *Land cover grid*: select **postfire**

II. Look-up table: select **mrlc2001_lut_fire**

C. *Soils* tab

I. *Soils layer*: select **gsmsoilmu_a_az**

II. *Soils database*: navigate to and select **C:\AGWA2\gisdata\tutorials\tutorial_MarshallGulchRehabilitation\gsmsoil_az\soildb_US_2002.mdb**

D. Click *Continue*.

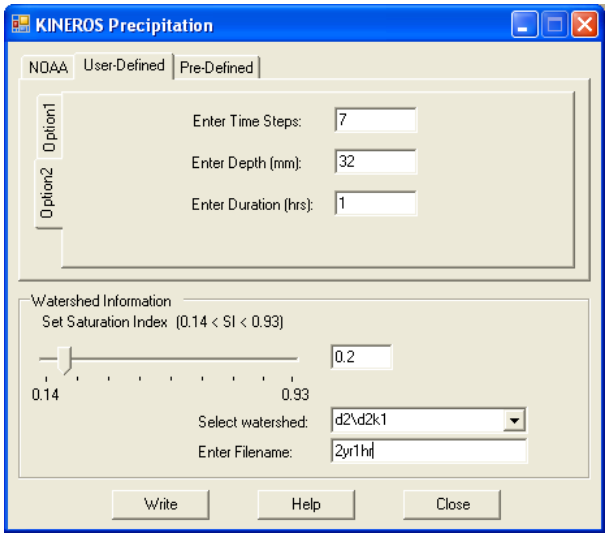
5. Write the KINEROS precipitation file for the watershed by selecting the *Write KINEROS Precipitation* menu item from the *AGWA2 Tools -> Precipitation Options* menu.
Two different average return periods will be used to demonstrate the impacts of different size events. An abridged table from NOAA's National Weather Service Precipitation Frequency Data Server (PFDS, http://hdsc.nws.noaa.gov/hdsc/pfds/) for the Marshall Gulch rain gage location (32.419874N, 110.751911W) is presented below. The 2 year, 1 hour and 50 year, 1 hour events will be used.

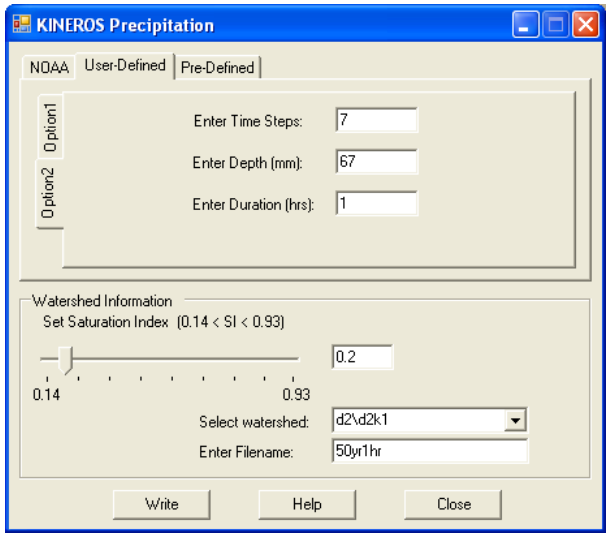
Precipitation Frequency Estimates (mm)										
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**
1	8	12	15	20	25	29	32	38	46	50
2	10	16	19	26	32	37	41	48	57	62
5	14	21	25	34	42	48	52	60	71	78
10	16	24	30	40	50	57	61	70	83	91
25	19	29	36	48	60	68	73	84	99	110
50	21	32	40	54	67	77	83	96	112	124
100	24	36	45	60	74	86	93	108	126	139
200	26	39	49	66	82	95	104	120	140	155

500	29	44	55	74	91	108	118	137	159	177
1000	31	48	59	80	99	118	130	150	174	195

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.





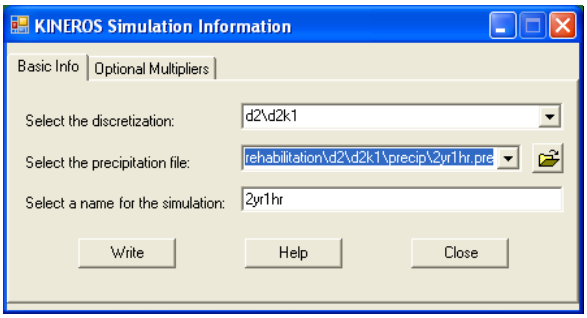
A. *KINEROS Precipitation* form
   I. *User-Defined* tab:
      a. *Option 2* tab:
         i. *Enter Time Steps*: **7**
         ii. *Enter Depth (mm)*: **32**
         iii. *Enter Duration (hrs)*: **1**
   II. *Watershed Information* box:
      a. *Set Saturation Index* slider: **0.2**
      b. *Select Watershed*: **d2/d2k1**
      c. *Enter Filename:* **2yr1hr**
   III. Click *Write*

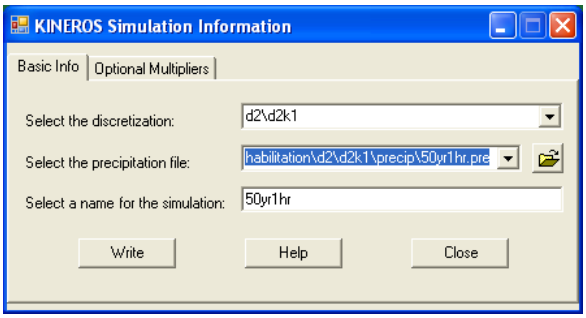
6. Repeat for the 50 year, 1 hour event. Select the *Write KINEROS Precipitation* menu item from the *AGWA2 Tools -> Precipitation Options* menu.
   A. *KINEROS Precipitation* form
      I. *User-Defined* tab:
         a. *Option 2* tab:
            i. *Enter Time Steps*: **7**
            ii. *Enter Depth (mm)*: **67**
            iii. *Enter Duration (hrs)*: **1**
      II. *Watershed Information* box:
         a. *Set Saturation Index* slider: **0.2**

b. *Select Watershed*: **d2/d2k1**
c. *Enter Filename:***50yr1hr**

III. Click *Write*

7. Write the KINEROS simulation input files for the watershed by selecting the *Write Input Files* menu item from the *AGWA2 Tools -> Simulation Options -> KINEROS* menu.





A. *Basic Info* tab:

I. *Select the discretization*: **d2\d2k1**

II. *Select the precipitation file*:**2yr1hr**

III. Select a name for the simulation: **2yr1hr**

IV. Click *Write*.

8. Repeat the writing of input files for the 50yr1hr event. Select the *Write Input Files* menu item from the *AGWA2 Tools -> Simulation Options -> KINEROS* menu.

A. *Basic Info* tab:

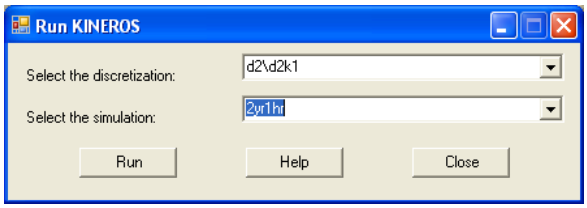
I. *Select the discretization*: **d2\d2k1**

II. *Select the precipitation file*: **50yr1hr**

III. Select a name for the simulation: **50yr1hr**

IV. Click *Write*.

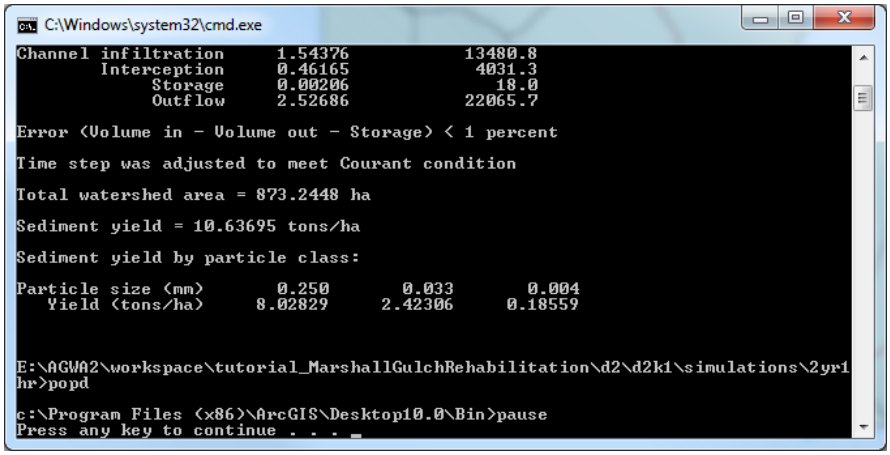
9. Run the KINEROS model for the Marshall Gulch watershed by selecting the *Run KINEROS* menu item from the *AGWA2 Tools -> Simulation Options -> KINEROS* menu.



A. *Select the discretization*: select **d2\d2k1**

B. *Select the simulation*: select **2yr1hr**

C. Click *Run*. The command window will stay open so that successful completion can be verified. Press any key to continue.

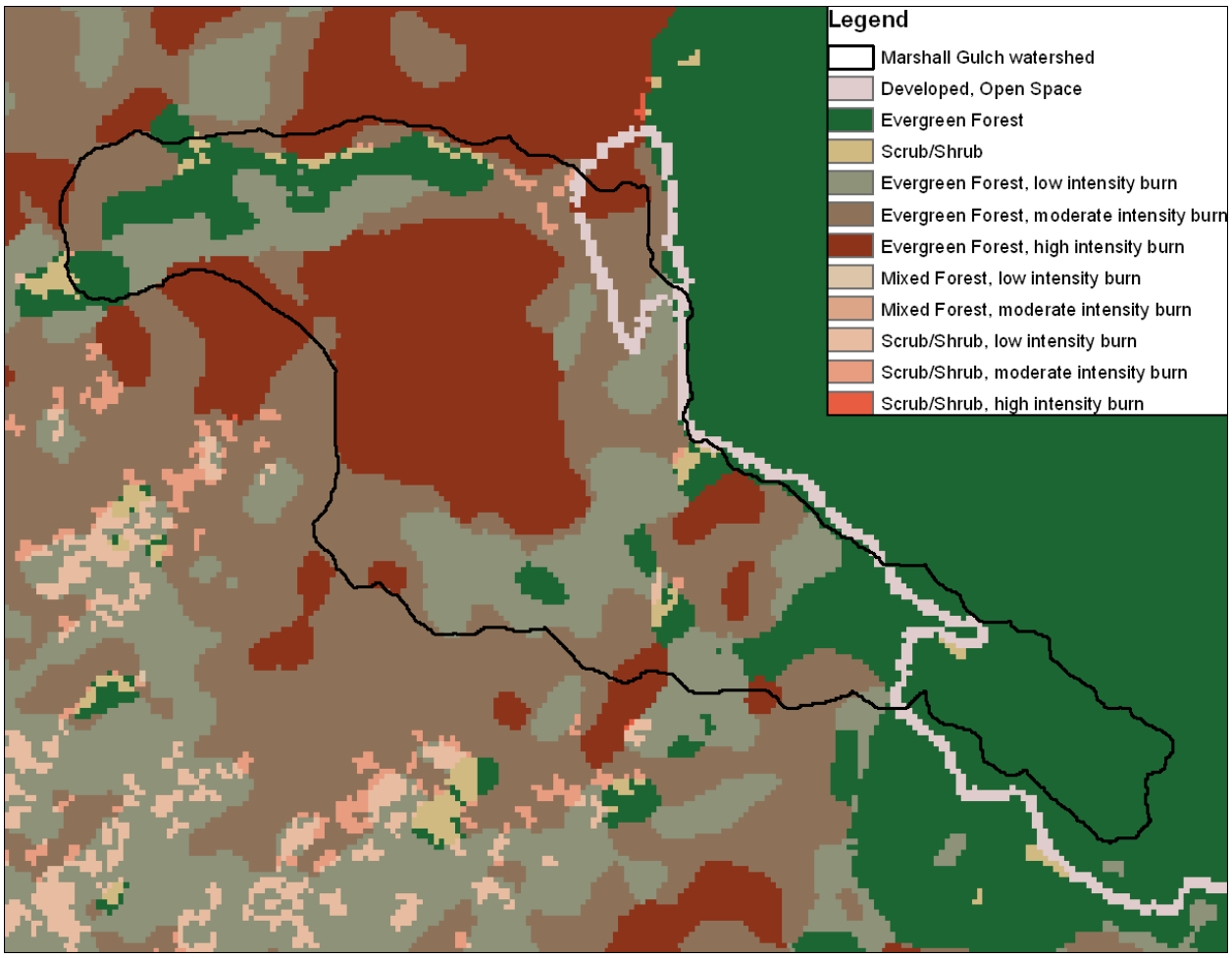


10. Repeat for the 50yr1hr event.
    A. *Select the discretization*: select **d2\d2k1**
    B. *Select the simulation*: select **50yr1hr**
    C. Click *Run*. The command window will stay open so that successful completion can be verified. Press any key to continue.

At this point, post-burn conditions have been simulated; treated, post-burn land cover will be created in part 2 and then simulated in part 3 so that the analysis can be performed in part 4.

Part 2: Create Treated, Post-Fire Land Cover

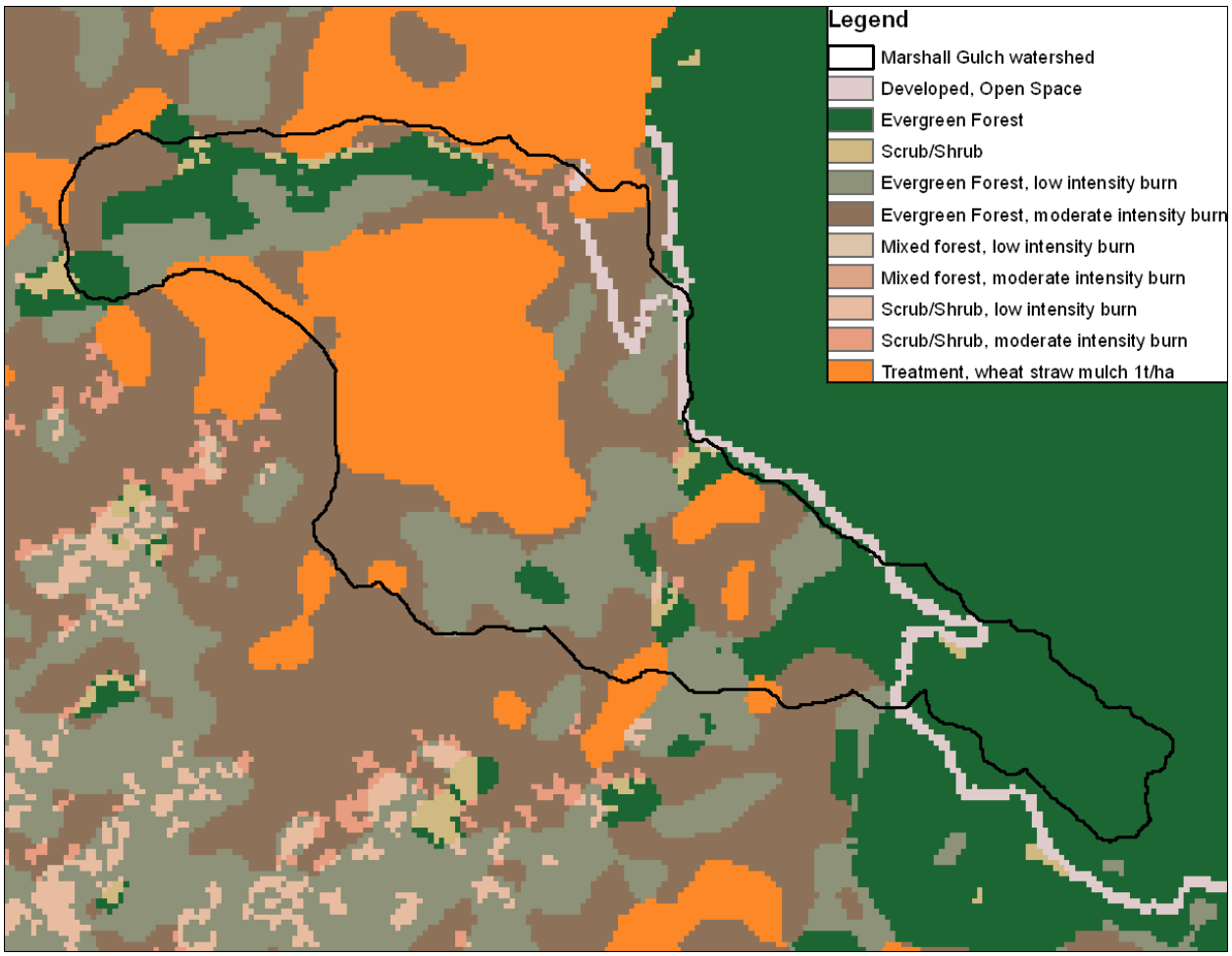
In Part 2, the post-fire land cover will be used along with a treatment map representing the locations of high burn severity to create a treated, post-fire land cover product. The treatment map represents only the location of high burn intensities to better focus labor on the more critical areas.



1. Perform the land cover modification for the proposed schools by selecting the *Land Cover Modification Tool* menu item from the *AGWA2 Tools -> Other Options* menu.
    A. *Input Land Cover* tab
        I. *Land cover grid*: select **postburn**
        II. *Look-up table* combobox: select **mrlc2001_lut_fire**
    B. *Output Land Cover* tab
        I. *Output folder*: navigate to and select **C:\AGWA2\workspace\tutorial_MarshallGulchRehabilitation**
        II. *New land cover name*: enter **treated**
    C. *Polygon Definition* tab
        I. *Polygon feature class*: select **treatment**
        II. *Create?* radiobuttons: select ***No***
        III. Select the *Select Features* tool  and drag a box around the features in the selected feature class.
    D. *Modification Scenario* box
        I. *Single Change* tab
            a. Select ***Change entire polygon*** radiobutton

b. *To type*: select **Treatment, wheat straw mulch 1t/ha**

E. Click *Process*.



Part 3: Modeling Runoff in Study Area Using Proposed Post-Development Land Cover

In Part 3, the initial land cover and soils parameterization of the watershed will be overwritten by the treated land cover dataset created in part 2. The new parameterization will be used to write a different set of model input files to execute the model.

1. Perform the land cover and soils parameterization of the Marshall Gulch watershed by selecting the *Land Cover and Soils Parameterization* menu item from the *AGWA2 Tools* -> *Parameterization Options* menu.

A. *Watershed* tab

I. *Discretization*: select **d2\d2k1**

B. *Land Cover* tab

I. *Land cover grid*: select **treated**

II. Look-up table: select **mrlc2001_lut_fire**

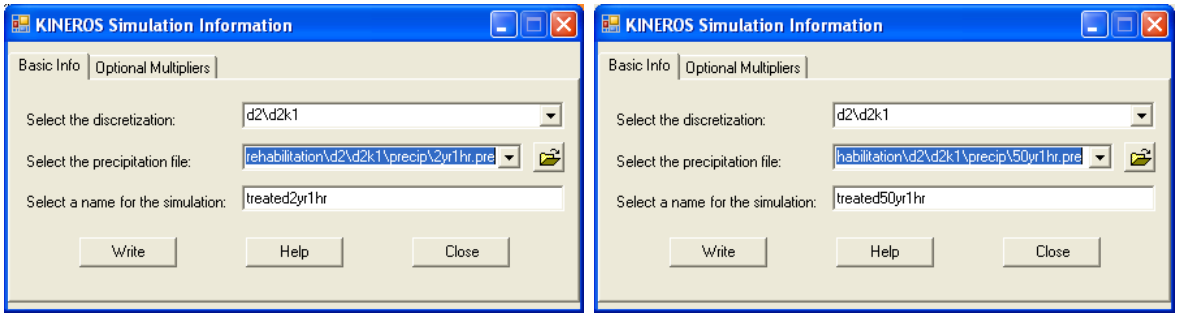
C. *Soils* tab

I. *Soils layer*: select **gsmsoilmu_a_az**

II. *Soils database*: navigate to and select **C:\AGWA2\gisdata\tutorials\tutorial_MarshallGulchRehabilitation\gsmsoil_az\soildb_US_2002.mdb**

D. Click *Continue*.

2. The same precipitation files used in the earlier simulations will be used in the treated fire simulations, so the writing of the KINEROS precipitation files performed earlier will be skipped now.
3. Write the KINEROS simulation input files for the watershed by selecting the *Write Input Files* menu item from the *AGWA2 Tools -> Simulation Options -> KINEROS* menu.



A. *Basic Info* tab:

I. *Select the discretization*: **d2\d2k1**

II. *Select the precipitation file*:**2yr1hr**

III. Select a name for the simulation: **treated2yr1hr**

B. Click *Write*.

4. Repeat the writing of input files for the 50yr1hr event. Select the *Write Input Files* menu item from the *AGWA2 Tools -> Simulation Options -> KINEROS* menu.

A. *Basic Info* tab:

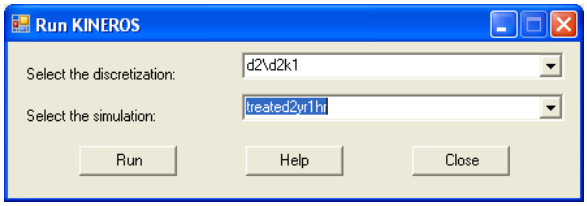
I. *Select the discretization*: **d2\d2k1**

II. *Select the precipitation file*: **50yr1hr**

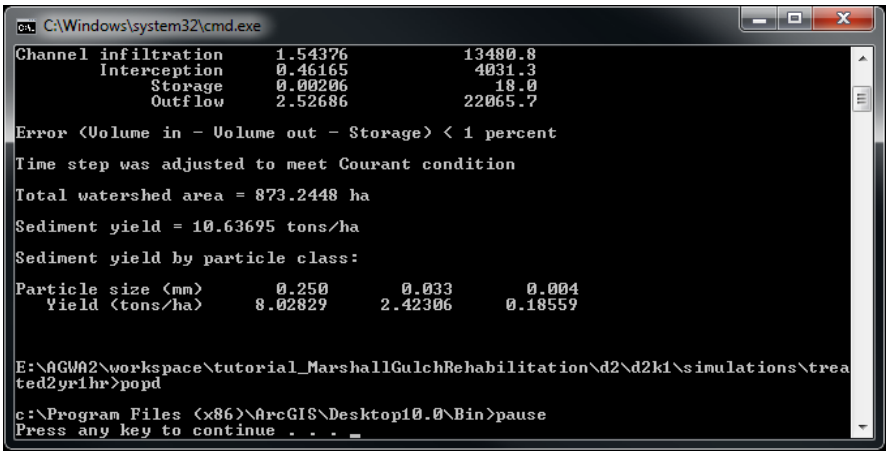
III. Select a name for the simulation: **treated50yr1hr**

B. Click *Write*.

5. Run the KINEROS model for the 2yr1hr event by selecting the *Run KINEROS* menu item from the *AGWA2 Tools -> Simulation Options -> KINEROS* menu.



   A. *Select the discretization*: select **d2\d2k1**
   B. *Select the simulation*: select **treated2yr1hr**
   C. Click *Run*. The command window will stay open so that successful completion can be verified. Press any key to continue.



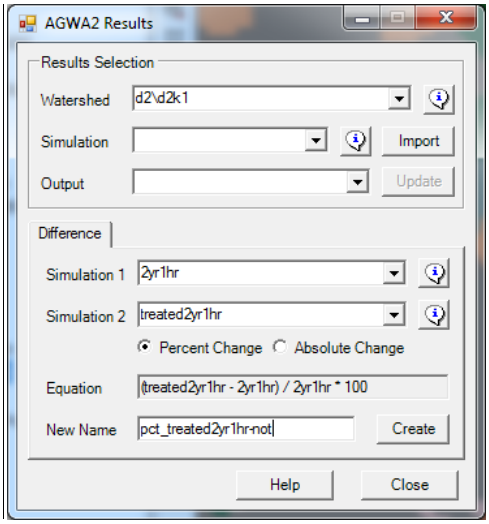
6. Repeat for the 50yr1hr event.
   A. *Select the discretization*: select **d2\d2k1**
   B. *Select the simulation*: select **treated50yr1hr**
   C. Click *Run*. The command window will stay open so that successful completion can be verified. Press any key to continue.

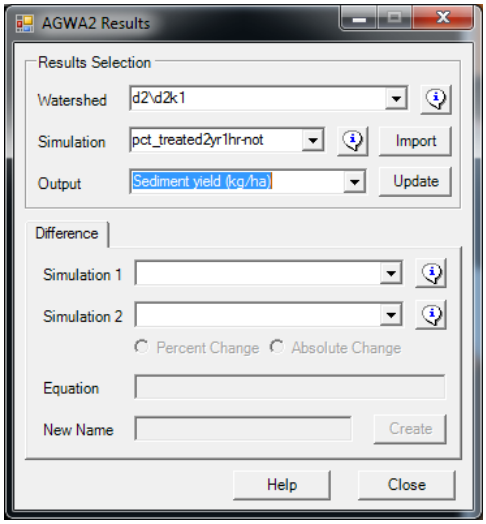
At this point, post-burn and treated, post-burn conditions have been simulated; in part 4, the post-burn and treated, post-burn simulations will be directly compared.

Part 4: Comparing Results from Post-burn and Treated Scenarios

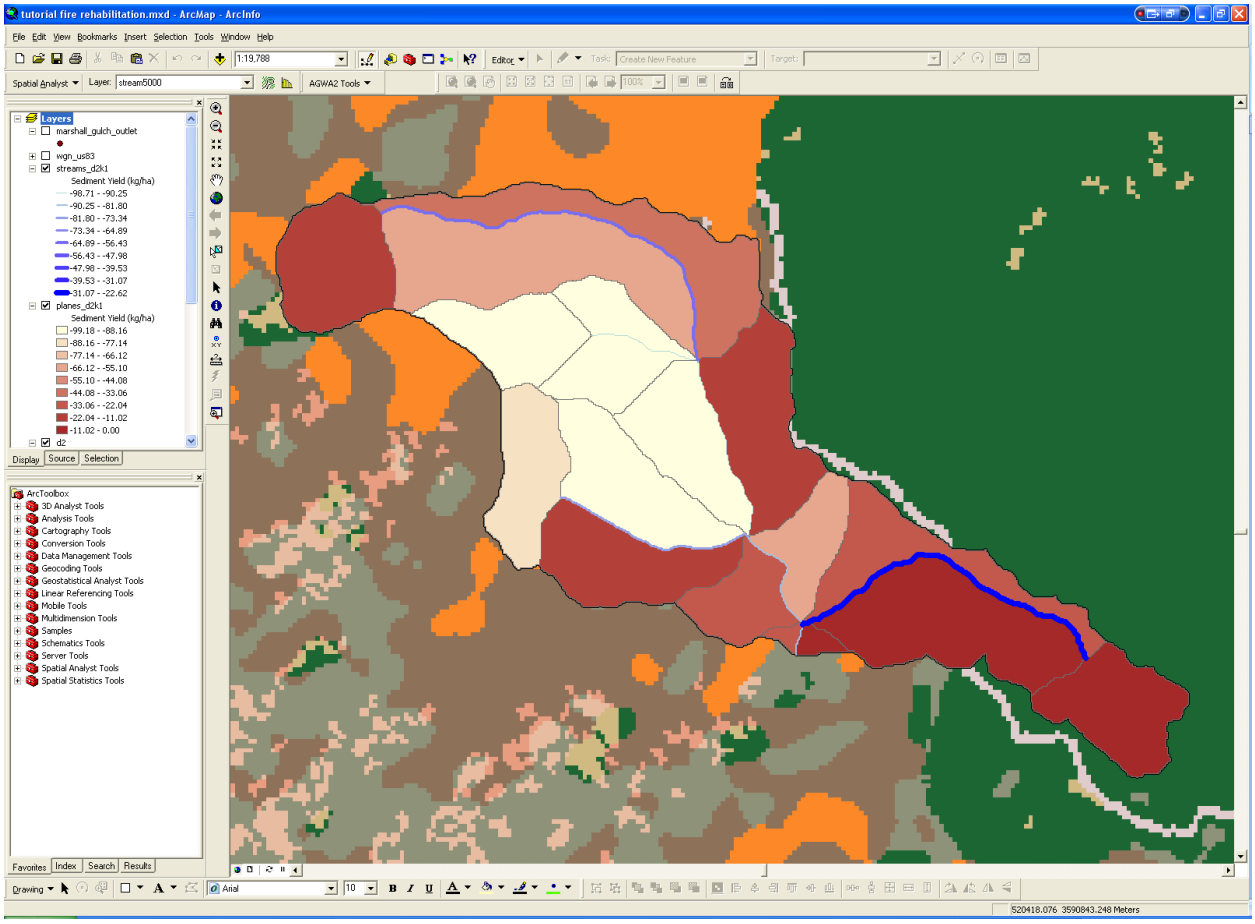
In Part 4, the results from the pre-burn and post-burn simulations will be imported into AGWA. These results will then be differenced to visualize how the treatment impacts the hydrology of the watershed.

1. Import the results from the two simulations by selecting the *View KINEROS Results* menu item from the *AGWA2 Tools -> View Results* menu.





   A. Results Selection box
      I. *Watershed*: select **d2\d2k1**
      II. *Simulation*: click **Import**
         a. **Yes** to importing **2yr1hr**
         b. **Yes** to importing **50yr1hr**
         c. **Yes** to importing **treated2yr1hr**
         d. **Yes** to importing **treated50yr1hr**
2. Difference the post-burn and treated, post-burn simulation results.
   A. *Difference* tab
      I. *Simulation1*: select **2yr1hr**
      II. *Simulation2*: select **treated2yr1hr**
      III. Select **Percent Change** radiobutton
      IV. *New Name*: enter **pct_treated2yr1hr-not**
      V. Click **Create**
   B. Repeat for the 50yr1hr event.
      I. *Simulation1*: select **50yr1hr**
      II. *Simulation2*: select **treated50yr1hr**
      III. Select **Percent Change** radiobutton
      IV. *New Name*: enter **pct_treated50yr1hr-not**
      V. Click **Create**
3. View the differenced results.
   A. *Results Selection* box
      I. *Watershed*: select **d2\d2k1**
      II. *Simulation*: select **pct_2yr1hr-not**
      III. *Output*: select **Sediment Yield (kg/ha)**
      IV. Click **Update**.



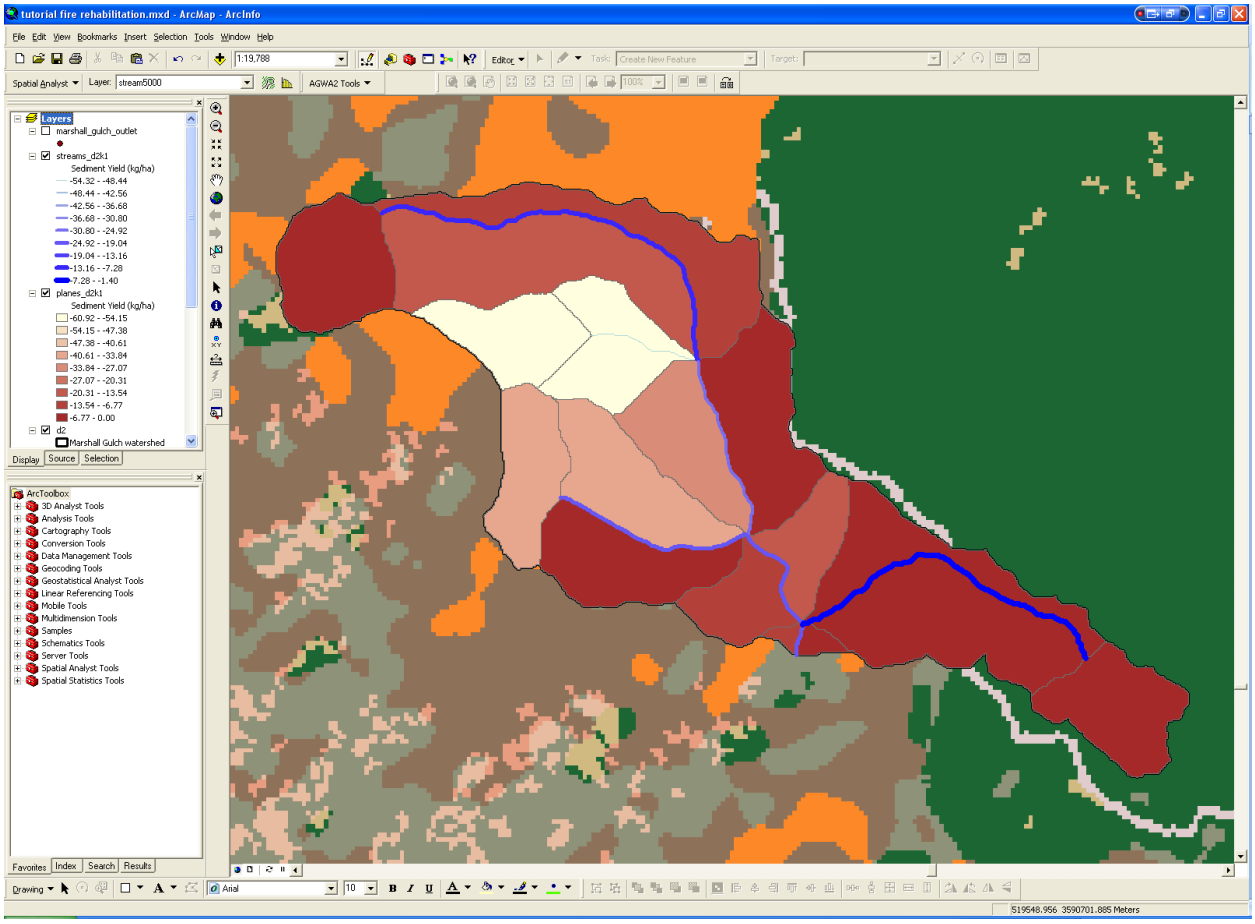
B. Repeat for the 50yr1hr differenced results. *Results Selection* box

I. *Watershed*: select **d2\d2k1**

II. *Simulation*: select **pct_50yr1hr-not**

III. *Output*: select **Sediment Yield (kg/ha)**

IV. Click **Update**.


tutorial fire rehabilitation.mxd - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Tools Window Help
Spatial Analyst
Layer: stream5000
AGWA2 Tools
Layers
marshall_gulch_outlet
streams_d2k1
Sediment Yield (kg/ha)
-54.32 - -48.44
-48.44 - -42.56
-42.56 - -36.68
-36.68 - -30.80
-30.80 - -24.92
-24.92 - -19.04
-19.04 - -13.16
-13.16 - -7.28
-7.28 - -1.40
planes_d2k1
Sediment Yield (kg/ha)
-60.92 - -54.15
-54.15 - -47.38
-47.38 - -40.61
-40.61 - -33.84
-33.84 - -27.07
-27.07 - -20.31
-20.31 - -13.54
-13.54 - -6.77
-6.77 - 0.00
d2
Marshall Gulch watershed
Display Source Selection
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Management Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Mobile Tools
Multidimension Tools
Samples
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Favorites Index Search Results
Drawing
Arial
519548.956 3590701.885 Meters

References

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